ARPA-E's 37 Projects Selected From Funding Opportunity Announcement #1

Project Title:	**Electric Field Swing Adsorption for Carbon Capture Applications**
Organization:	**Lehigh University**
Funding Amount:	**$566,641**
Website:	**www3.lehigh.edu/engineering**

Brief Description of Project

Electric Field Swing Adsorption (EFSA) is a fundamentally new approach for separation of carbon dioxide from flue gases of coal-fired power plants. The key feature of this new technology is the use of electric fields to reversibly and selectively enhance the affinity of CO_2 for high surface area solid sorbent materials. This means that both adsorption and desorption can be done under ambient conditions, simply by switching the electric field on and off, avoiding the need for costly heating or pressurization cycles. The current project is focused on developing the scientific basis of the EFSA technology, and determining its practicality for carbon capture applications. The first phase of the project aims to establish proof of concept of the EFSA technique, and to tailor solid sorbent materials and to optimize the field induced adsorption change. Once a suitable system has been identified, we will initiate the second phase of the project, to develop a bench-top gas separation reactor that is capable of CO_2 separation from a simulated flue-gas mixture.

Why ARPA-E Funding and Not Private Capital

EFSA was conceived specifically for this initial ARPA-E FOA as a fundamentally new and potentially game-changing approach to carbon capture. While a preponderance of evidence exists in the scientific literature that indirectly supports the underlying science behind the EFSA approach, it has not yet been demonstrated at the proof of concept level. The potential for transformational impact is high, as is the risk, which likely precludes private funding at this early stage.

Uniqueness/Benefits of Technology

Conventional gas separation methodologies like Thermal and Pressure Swing Adsorption (TSA) and (PSA) consume large quantities of energy and time for desorption. In Electric Field Swing Adsorption (EFSA), adsorption and desorption can be switched quickly by varying an electric field to the sorbent without current flow, temperature, and pressure changes.

Key Team Member Bios

Prof. Kai Landskron and **Prof. David Moore** are the principal investigators of the project who will supervise the work. This is a truly multidisciplinary project that was conceived and developed as a partnership between the co-PI's, drawing on their distinctly different backgrounds in materials chemistry (Landskron), and physical chemistry (Moore). Within Prof. Landskrons group, Dr. Paritosh Mohanty (postdoc) and Cong Liu (graduate student), will synthesize/procure the sorbent materials to study EBSA and EFSA using volumetric and gravimetric gas sorption techniques. Furthermore, they will synthesize carbon thin films of various thicknesses and with different pore symmetries to make carbon electrodes for the fixed bed reactors. Within the Moore group, Nina Finamore (graduate student) will design custom instrumentation for the project, and conduct spectroscopic characterizations of the sorbents under EBSA/EFSA conditions.

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Addressable Market & Potential Customers

The primary market of this project is the future market of carbon capture in coal-fired power plants. Further markets may evolve from the adaption of the proposed EFSA technology to other gas separation applications, such as: separation of CO2 from methane and air separation. Primary potential customers are utility companies with business in power generation from coal-fired power plants.

Testimonials

The stated mission of ARPA-E to support the development of transformational approaches to fossil fuel reduction and greenhouse gas abatement represents a welcome paradigm shift in science and technology funding. It is vital that a portion of the overall funding be designated for development of high-risk, high-reward proposals that have the potential to revolutionize their respective fields. While the overall success rate of these proposals may be low, it will only take a few successful proposals to make the initial investment of $150 million worth it to the American taxpayers. Furthermore, the ARPA-E staff has been communicative, helpful, and efficient, and it has been our pleasure to work with them so far.

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